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**AEROSPACE PAYLOAD DESIGN
AND DEVELOPMENT**

Richard B. Gates

Wentworth Institute of Technology
Wentworth Laboratories
550 Huntington Avenue
Boston, Mass 02115

4 November 1992

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**Final Report
March 1988-May 1992**

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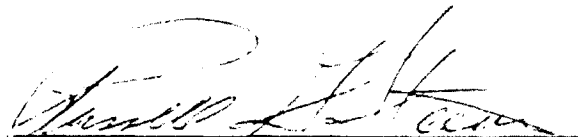


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AIR FORCE MATERIEL COMMAND
HANSCOM AIR FORCE BASE, MA 01731-5000**

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1.0 INTRODUCTION

Summarized in this report is the work performed under contract F19628-88-C-0031 from March 24, 1988 into May 31, 1992. (An extension was granted on Modification P00082, April 29, 1992, making the period of work 50 months). Efforts consisted of design and fabrication of one-of-a-kind payloads and flight instruments, ground equipment, field launch services and refurbishment of recovered payloads and instruments.

1.1 PROGRAM SUMMARY

Wentworth's primary task accomplished under Contract F19628-88-C-0031 was to provide design, engineering and fabrication support for Phillips Laboratory toward the development of payloads for infrared measurements and other physical science experiments in space. Specific services provided included mechanical design and analysis of mechanical pieces and electro-mechanical devices, development of cost effective fabrication techniques, testing and field support of the hardware. Also provided were the design, fabrication, assembly, testing and integration of electronic devices including PCB's and their circuitry. Wentworth's long experience in payload support contributed to being a cost effective supplier of diverse services at close proximity to Phillips Laboratory. The results of this contract added to the existing success record and expertise of Wentworth and enabled us to win the succeeding contract with Phillips Laboratory, F19628-92-C-0096.

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2.0 PROJECTS

An overview of 28 projects that Wentworth participated in is presented in this section. Additional projects that Wentworth was involved in to a lesser degree are listed in 2.29. The format by which these projects are reviewed is as follows:

Title - Acronym or project name.

() - Digitized code number for project from AFGL or 3 digit project number from WIT's Contract Reporting System.

Dates - Period of time during which work was performed by WIT.

Configuration/Mission - Launch vehicle, brief payload and mission description (when known).

Task Elements - Wentworth's level of effort in the project.

Summary - Results of Wentworth's efforts and launch date (if known).

2.1 SHAKE PLATE, BOOM/CAN (101,102) - July 1988 - September 1988

2.1.1 Configuration/Mission - A 44" diameter Aries payload designed to produce neutral particle beams in space and study their interaction.

2.1.2 Task Elements - Staff personnel designed a shake plate and supported the ground testing of the BEAR payload.

2.1.3 Summary - TM/Physics can was successfully tested and integrated. Launch was successful July 13, 1989.

2.2 EXCEDE III (120) July 1988 - March 1991

2.2.1 Configuration/Mission - A 38" diameter Aries payload with an electron gun section and an instrument section.

2.2.2 Task Elements Design and subcontracting of Aries Launch Preparation Shelter at White Sands Missile northern range. Work continued after the EXCEDE III launch to modify the structure for various size rockets and different missions.

2.2.3 Summary EXCEDE III was successfully prepared and flown April 1991.

2.3 REFS, REFS 2 (121,123) - January 1990 - June 1992

2.3.1 Configuration/Mission Small 2.75" diameter rockets intended to determine the electrostatic field distribution prior to conventional attempts to trigger lightning with small rockets towing wires.

2.3.2 Task Elements Design and fabrication of several payloads containing electronics and batteries with an outer rotating shell.

2.3.3 Summary Many of the payloads built by Wentworth were successfully flown in the summers of 1990 - 1992.

2.4 ULPS, ULPS II (122,676) - October 1990 - March 1992

2.4.1 Configuration/Mission The Universal Launch Preparation Shelter was built to house the SPIRIT II and other launch preparations at Poker Flats, Alaska.

2.4.2 Task Elements Wentworth designed, analyzed and contracted out the construction of the horizontal shelter.

2.4.3 Summary Construction was completed on the structure and SPIRIT II was successfully launched.

2.5 LLTV, AIS, TRANSMITTER, CIV, GSE, VIBRATION, BAFFLE, SAUNDERS, CIV MODIFICATIONS (201,202,203,204,205,206,207,208,211)
-July 1988 - June 1991

2.5.1 Configuration/Mission Infrared Background Signature Survey (IBSS) was shuttle based experiment using a Shuttle Pallet Satellite as a space platform to make standoff measurements of infrared, ultraviolet and visible optical backgrounds and measurements. Other parts of the IBSS experiment remained in the Shuttle cargo bay to provide phenomenon for observation.

2.5.2 Task Elements Camera housings and baffles, electronic boxes, ground support equipment and test support were provided to AFGL.

2.5.3 Summary All equipment provided was flown and performed satisfactory on Discovery's Mission 39 in May 1991.

2.6 VIPER (209) October 1988 - December 1990

2.6.1 Configuration/Mission Visual Photometric Experiment (VIPER) is a Getaway Special Canister (GAScan) that flew in the cargo bay of the Shuttle. Its objective was to measure the diffuse zodiacal and galactic emissions at the B, R, and V standard astronomical wavelengths.

2.6.2 Task Elements Wentworth designed and fabricated all mechanical structures and devices for the internal support, electronic packaging, camera housings and filter drive wheel. Support electronics for the wheel, shutters, recorder and housekeeping were also designed and built.

2.6.3 Summary VIPER was successfully flown on STS 42 in January 1992.

2.7 LANGMUIR PROBE (401) - July 1988 - June 1990

2.7.1 Configuration/Mission These sensor probes are used on various upper atmospheric missions. The final use for the probes in this period is unknown.

2.7.2 Task Elements Staff personnel built seven electron density probes and their protective covers.

2.7.3 Summary Hardware was delivered on time and in cost.

2.8 POSITIONING TABLE (408) - April 1989 - December 1990

2.8.1 Configuration/Mission The testing of Electro-Static Analyzers must be done in a variety of positions in a vacuum. These ESA's are used on many different missions.

2.8.2 Task Elements Wentworth designed and built a four degree of freedom positioning table that can be used in a high vacuum chamber.

2.8.3 Summary Hardware was delivered on time and has proved to be successful as ground support testing.

2.9 CATHODE ASSY (409) - July 1989 - December 1990

2.9.1 Configuration/Mission Various experiments require the generation of a plasma while in the upper atmosphere.

2.9.2 Task Elements Wentworth re-engineered a plasma contactor from a NASA design.

2.9.3 Summary Hardware proved satisfactory in ground tests.

2.10 3RD SCEX UNIT (411) - October 1989 - September 1990

2.10.1 Configuration/Mission SCEX

2.10.2 Task Elements Wentworth built and packaged the components including power supplies, tri-quadraserphical collector and channeltrons in two Electro-static analyzers for SCEX. They were follow-ons to similar ESA's flown on ECHO-7 and therefore called "3rd".

2.10.3 Summary Hardware was delivered working and on time.

2.11 FARADAY CUP (412) - December 1989 - March 1990

2.11.1 Configuration/Mission Ground support and testing.

2.11.2 Task Elements Wentworth designed and built a "Faraday Cup" to aid in GL ion calibration system.

2.11.3 Summary Hardware was delivered on time.

2.12 LIFE (414) January 1990 - March 1991

2.12.1 Configuration/Mission LIFE

2.12.2 Task Elements Provide hardware support for the design, fabrication and testing of a guidance platform and parachute recovery system, preflight analysis and documentation for the guidance system and integration and launch operations support.

2.12.3 Summary Hardware for the guidance system and parachute recovery systems were provided. Program was canceled before integration and launch support was required.

2.13 POLAR GSE (415) - July 1990 - September 1991

2.13.1 Configuration/Mission POLAR

2.13.2 Task Elements Design and fabricate GSE cabling for the POLAR program.

2.13.3 Summary Cabling was delivered on time.

2.14 LCLV/ROBIE (416) - July 1990 - September 1990

2.14.1 Configuration/Mission Low Cost Launch Vehicle (LCLV)/ROBIE was a SDIO experiment intended to place a single diode electron beam system in the upper atmosphere along with twenty current robes and a gas ejection device.

2.14.2 Task Elements Design and build mechanical electron beam parts, blow away doors and gas release device, structures and support brackets, and current probe electronics box and relay unit support.

2.14.3 Summary Parts were delivered on time. Flight was successfully flown in February 1991.

2.15 PASP PLUS/PASP PLUS II/PASP PLUS III (417,418,669)
-January 1991 - June 1992

2.15.1 Configuration/Mission Photovoltaic Array Space Power Plus Diagnostics (PASP Plus) puts in space twelve advanced solar array designs and associated diagnostic instrumentation to test their operation in the space plasma environment.

2.15.2 Task Elements Wentworth provided engineering support for the design of the Langmuir probe and Sensor Potential (SENPOT) circuits. The actual Langmuir probe, flight qualified electronic components and electronic packaging were also provided.

2.15.3 Summary PASP Plus is scheduled for flight in late 1992.

2.16 DIGBE (501) - September 1988 - June 1989

2.16.1 Configuration/Mission A 21" diameter Aries payload with electro mechanical devices and infrared sensors designed to study interstellar clutter with a rotating out of line of flight sensor.

2.16.2 Task Elements Wentworth performed various electronics tests for continuity and functionality on the CVFS and other electro-mechanical devices and circuits in preparation for refurbishment.

2.16.3 Summary Funding was cut, preventing further work.

2.17 COLDR II (502) - September 1988 - March 1990

2.17.1 Configuration/Mission The efforts expended in the project titled Conductivity of the Lower D-Region (COLDR II) were to support two missions. COLDR II was a 12" - 14" payload on top of Nike-Orion rocket. Micro-COLDR was a smaller payload on a Super Arcus rocket. Both projects intended to investigate the conductivity of the lower D-region by moving a mass spectrometer through the region by descending parachute.

2.17.2 Task Elements Wentworth supplied various mechanical parts for the parachute, pressure, despin and transition sections and electronic parts for the deployment guns, pressure monitoring instruments and connectors.

2.17.3 Summary Hardware was delivered on time and fully tested.

2.18 MASS SPEC, MASS SPEC II (504, 674) - September 1988 - March 1992

2.18.1 Configuration/Mission Unknown

2.18.2 Task Elements Electronic circuit boards, harnesses and mechanical housings typical of mass spectrometers were to be made.

2.18.3 Summary Parts were delivered on time.

2.19 ASC / TIPACT (505) - June 1990 - March 1992

2.19.1 Configuration/Mission TIPACT (Totally Integrated Payload Attitude Control Tester) is a device to test inertial guidance units for sounding rockets and replace less sophisticated one degree of freedom systems.

2.19.2 Task Elements Fabricate the mechanical parts for TIPACT, test samples of Kevlar straps.

2.19.3 Summary Parts delivered on time.

2.20 FLOW TUBE (506) - September 1990 - December 1990

2.20.1 Configuration/Mission Unknown

2.20.2 Task Elements Provide design and fabrication support for vacuum hardware for the High Temperature Flow Tube Experiment

2.20.3 Summary Engineering and fabrication support were provided on an as needed basis.

2.21 METEOR SCATTERING, CHEMICAL MODELING (651, 652)

-July 1988 - September 1990

2.21.1 Configuration/Mission Unknown

2.21.2 Task Elements Provide engineering support in the equilibrium composition and thermochemical properties for atmospheric wake species important in rocket plumes and re-entry phenomena.

2.21.3 Summary Studies were completed on time and in cost.

2.22 CONCORD SCIENCES, CONCORD SCIENCES II, CONCORD SCIENCES III
(653,663,709) - September 1988 - December 1990

2.22.1 Configuration/Mission Unknown

2.22.2 Task Elements In conjunction with Concord Sciences, Wentworth provided engineering services in the areas of equilibrium computer analyses, non-equilibrium model computations of flowfield elements, full-scale and simulated hypersonic flight measurements, all of which supported the development of hypersonic flowfield chemistry.

2.22.3 Summary Analyses and reports provided to the satisfaction of AFGL.

2.23 YORK (654) - January 1989 - September 1990

2.23.1 Configuration/Mission Unknown

2.23.2 Task Elements In conjunction with York University, Wentworth provided engineering services for methods to add chemicals to plasmas to decrease ion and free electrons and their associated measurements.

2.23.3 Summary Analyses and reports provided to the satisfaction of AFGL.

2.24 SANDIA (656) - April 1989 - March 1991

2.24.1 Configuration/Mission Unknown

2.24.2 Task Elements Wentworth to provide design, fabrication and testing support for mechanisms to inject chemicals into a flow field.

2.24.3 Summary Support was provided until the project was canceled preventing final results.

2.25 SpaDVOS (657) - July 1989 - June 1990

2.25.1 Configuration/Mission The Spaceborne Direct-View Optical System (SpaDVOS) was a folded-optical path telescope system which mounted inside the Shuttle's over-head cabin window to permit real time direct view observation of terrestrial ground sites from the Shuttle orbiter. This project was to be a study of a second generation system.

2.25.2 Task Elements Wentworth, in conjunction with SSG, Inc., provided a engineering design of an improved SpaDVOS with optical performance parameters and ergonomic factors.

2.25.3 Summary The design was provided to AFGL.

2.26 WAKE/RAM EXPERIMENT, WAKE RAM II, CHAW II, CHAW III (659, 664, 675, 677, 678)
- January 1990 - March 1992

2.26.1 Configuration/Mission The Wake/Ram or CHAWS Program (Charge and Wake Studies) is a shuttle free flier that will generate an extremely high vacuum in order to create ultra-pure thin films in space.

2.26.2 Task Elements Wentworth designed and built the wake plasma sensor that will be flown on the outer perimeter of the 12 foot shield.

2.26.3 Summary Hardware was delivered on time. The University of Houston's Wake Shield Facility will fly on the shuttle in mid-1993.

2.27 JOHN WILLIAMSON, II WILLIAMSON, III WILLIAMSON (661, 665, 671)
- July 1990 - May 1992

2.27.1 Configuration/Mission Selected Ion Flow Drift Tube

2.27.2 Task Elements Design and build the upgrade for the High Temperature Ion Source Apparatus, provided engineering support for the SIFDT apparatus.

2.27.3 Summary Work is on going to maintain and update the equipment with higher temperature capabilities.

2.28 PAUL MUNDIS, II MUNDIS, III MUNDIS (662, 667, 672) - July 1990 - May 1992

2.28.1 Configuration/Mission High Temperature Flowing Afterglow

2.28.2 Task Elements Perform electronic design and fabrication of the HTFA and SIFDT.

2.28.3 Summary Work was done on time.

2.29 Lesser Projects

Wentworth participated in a lesser manner in some projects by supplying hardware or services to AFGL (Phillips Laboratory). Our effort was not enough to be able to fully identify the extent of our participation or claim a full part in the project. Consequently, these projects are just listed below:

L.C. MISC	210
GROUND BASE	212
BILL SULLIVAN BOX	402
ANALYTYX REWORK	403
E.S.A.	406
P.C.BOARD	407
HUGHES DRAWING	410
AMPTEK	413
ABLE	503
HUNTON	507
CRYOGENIC HOUSING	658
ESA-SPEAR	660
SURFACE POTENTIAL MON	668

3.0 PERSONNEL

The value of experience should not be undervalued when rating an organization's capability to provide quality aerospace hardware and services at cost effective rates. The following individuals contributed to the projects as outlined in this report.

<u>Name</u>	<u>Title</u>	<u>Years at WIT</u>	<u>Total Exper. Years</u>	<u>Education</u>
Benassi, Howard	Spvr, Manuf.	4	34	AS
Brisebois, Normand	Machinist	1	1	AS
Butler, Thomas	Machinist	2	2	BS
Cabral, Rudolph	Instr Maker	13	24	Cert.
Fritzler, Frederic	Instr Maker	40	40	Cert.
Gagnon, Jeffery	Machinist	1	1	BS
Gambale, Alfonso	Instr Maker	19	19	Cert.
Gideon, Saul	Machinist	1	1	AS
Larson, Jon	Mstr Mdl Mkr	7	7	BS
Reid, Matthew	Machinist	1	1	BS
Sharpe, Donald	Machinist	2	2	BS
Schavrien, William	Machinist	2	2	Cert.
Silva, Joeseeph	Instr Makr	6	30	AS
Theodore, Erwin	Exper Mach	25	32	As
Campbell, Thomas	Spvr, Elect.	23	23	BS
Cutter, George	EEng Tech V	30	30	BS
Dimilla, Thomas	EEng Tech V	34	34	AS
Mundis, Paul	EEng Tech V	27	44	AS
Nardella, Daniel	EEng Tech V	32	32	AS
Newell, Shawn	EEng Tech IV	5	5	BS
Rodrigues, Timothy	Elect Eng	5	5	BS
Smart, Lawrence	EEng Tech V	25	25	AS
LeBlanc, Edgar	Spvr, Mech	41	41	AS
Hartnett, Paul	Mech Eng Des	32	32	AS
Hurley, Patrick	Mech Eng Des	13	32	AS
Labelle, Paige	Mech Eng Coop	1	1	AS
Lund, Raynor	Mech Eng Des	8	27	AS
Murphy, Matthew	Mech Eng Des	5	10	BS
Gates, Richard	PI/Mech Eng	7	23	BS
Crawford, Angela	Secretary	1	1	AS
Deakyne, Carol	Chemist	4	14	PhD
De Hart, Donald	EEng Tech IV	3	20	AS
Joseph, June	Assist PI	12	15	Cert.
Rourke, Peter	Manuf Eng	10	15	BS

4.0 CHARTS AND GRAPHS

4.1 ACTIVITY BY QUARTER

The following chart is provided to allow tracking of Wentworth's activities on specific projects by quarter.

		CALENDAR YEAR																			
		68				69				90				91				92			
QUARTERLY REPORT		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
101	SHAKE PLATE	✓	✓																		
102	BOOM/CAN	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓								
120	EXCEDE III	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓								
121	REFS																				
122	ULPS													✓	✓	✓	✓				
123	REFS 2													✓	✓	✓	✓				
201	ULLTV	✓	✓																		
202	AIS	✓	✓	✓																	
203	TRANSMITTER	✓	✓	✓										✓							
204	CIV	✓	✓																		
205	GSE	✓	✓																		
206	VIBRATION	✓	✓																		
207	BAFFLE	✓	✓	✓																	
208	SAUNDERS	✓	✓	✓																	
209	VIPER	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓			
210	L.C. MSC.					✓	✓	✓	✓	✓	✓	✓	✓								
211	CIV MODIFICATIONS					✓	✓	✓	✓	✓	✓	✓	✓								
212	GROUND BASE					✓	✓	✓	✓	✓	✓	✓	✓								
401	LANGMUIR PROBE	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓								
402	BILL SULLIVAN BOX	✓	✓																		
403	ANALYTIX REWORK	✓	✓	✓	✓																
406	E.S.A.					✓	✓														
407	P.C. BOARD					✓	✓			✓											
408	POSITIONING TABLE					✓	✓	✓	✓	✓	✓	✓	✓								
409	CATHODE ASSY					✓	✓	✓	✓	✓	✓	✓	✓								
410	HUGHES DRAWING					✓															
411	3RD SCEX UNIT							✓	✓	✓	✓	✓	✓								
412	FARRADAY CUP							✓	✓												
413	AMPTEX							✓													
414	LIFE							✓						✓	✓						
415	POLAR GSE									✓	✓	✓	✓	✓	✓	✓					
416	LCLV													✓							
417	PASP PLUS													✓	✓			✓	✓	✓	✓
418	PASP PLUS II																				
501	DIGBE		✓	✓	✓																
502	"COLD R II"		✓	✓	✓	✓	✓	✓	✓												
503	ABLE		✓	✓	✓	✓	✓	✓	✓												
504	MASS SPEC.		✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
505	ASC / TPACT									✓	✓	✓	✓	✓	✓	✓	✓				
506	FLOW TUBE													✓							
507	HUNTON													✓							
651	METEOR SCATTERING	✓	✓	✓	✓	✓	✓	✓	✓												
652	CHEMICAL MODELING	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓								
653	CONCORD SCIENCES		✓																		
654	YORK		✓	✓	✓																
655	650 SUPPLIES		✓							✓	✓	✓	✓	✓	✓						
656	SANDIA			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓						
657	SPADVOS			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓								
658	CRYOGENIC HOUSING					✓	✓	✓	✓	✓	✓	✓	✓								
659	WAKE/RAM EXPERIMENT							✓	✓	✓	✓	✓	✓	✓	✓	✓					
660	ESA-SPEAR									✓	✓										
661	JOHN WILLIAMSON									✓	✓	✓	✓								
662	PAUL MUNDIS									✓	✓	✓	✓								
663	CONCORD SCIENCES II													✓							
664	WAKE RAM II													✓	✓						
665	II WILLIAMSON													✓	✓	✓					
667	II MUNDIS													✓	✓	✓					
668	SURFACE POTENTIAL MON													✓	✓						
669	PASP PLUS III																	✓	✓		
671	III WILLIAMSON																	✓	✓	✓	✓
672	III MUNDIS																	✓	✓	✓	✓
674	MASS SPEC. II																	✓	✓	✓	✓
675	WAKE SHIELD																	✓	✓		
676	ULPS II																	✓	✓		
677	CHAW II																				
678	CHAW III																				
709	CONCORD SCIENCES III																				

ACTIVITIES
UNDER
F19628-88-C-0031
BY QUARTER

Table 1
Activity by Quarter

5.0 SELECTED DATA BASES

5.1 PERSONNEL BY MONTH

The following data is a listing by month of the personnel who worked on the contract. The numbers in the month columns are the WIT employee ID numbers.

L288.DOC

1988

DEC	NOV	OCT	SEP	AUG	JUL		JUN
1083	1083	1083	1083	1083	1083	BENASSI, HOWARD	1995
1169	1169	1169	1169	1169	1169	CAMPBELL, THOMAS	2490
1269	1269	1269	1269	1269	1269	CUTTER, GEORGE	2534
1285	1285	1285	1285	1285	1285	DEAKYNE, CARROL	3249
1289	1289	1289	1289	1289	1289	DE HART, DONALD	3458
1315	1315	1315	1315	1315	1315	DIMILLA, THOMAS	4041
			1405	1405	1405	SILVA, JOSEPH	4107
	1422	1422	1422	1422	1422	FRITZLER, FREDERIC	4146
1435	1435	1435	1435	1435	1435	GAMBALE, ALFONSO	4514
1441	1441	1441	1441	1441	1441	GATES, RICHARD	4745
1447	1447	1447	1447	1447		LARSON, JON	4976
1509	1509	1509	1509	1509	1509	HARTNETT, PAUL	5405
		1545	1545	1545	1545	HURLEY, PATRICK	5668
1573	1573	1573	1573	1573	1573	JOSEPH, JUNE	5978
1665	1665	1665	1665	1665	1665	LEBLANC, EDGAR	6286
1700	1700	1700	1700	1700	1700	LUND, RAYNOR	6318
		1778	1778		1778	MC.NEIL, CHRISTOPHER	7285
1850						MURPHY, MATHEW	8111
	1846	1846	1846	1846	1846	MUNDIS, PAUL	8802
1859	1859	1859	1859	1859	1859	NARDELLA, DANIEL	8807
1992						REID, MATTHEW	
	2020	2020	2020	2020	2020	RODRIGUEZ, TIMOTHY	
					2029	ROURKE, PETER	
2065						SHARPE, DONALD	
2110	2110	2110	2110	2110	2110	SMART, LAWRENCE	
					2185	THEODORE, ERWIN	
					2490	CABRAL, RUDOLPH	

L189.DOC

1989	JUN	MAY	APR	MAR	FEB	JAN	
1083	1083		1083			1083	BENASSI, HOWARD
1169	1169		1169	1169	1169	1169	CAMPBELL, THOMAS
1269	1269		1269	1269	1269	1269	CUTTER, GEORGE
1285	1285		1285	1285	1285	1285	DEAKYNE, CARROL
1289	1289		1289	1289	1289	1289	DE HART, DONALD
1315	1315			1315	1315		DIMILLA, THOMAS
1317	1317	1317					BRISIBOIS, NORMAND
1405							SILVA, JOSEPH
1435	1435	1435	1435	1435	1435	1435	GAMBALE, ALFONSO
1441	1441	1441	1441	1441	1441	1441	GATES, RICHARD
1447	1447	1447		1447		1447	LARSON, JON
1509	1509	1509	1509	1509	1509	1509	HARTNETT, PAUL
1545	1545	1545		1545			HURLEY, PATRICK
1573	1573	1573	1573	1573	1573	1573	JOSEPH, JUNE
1665	1665	1665	1665	1665	1665	1665	LEBLANC, EDGAR
1700	1700	1700	1700	1700	1700	1700	LUND, RAYNOR
1846	1846	1846	1846	1846	1846	1846	MUNDIS, PAUL
			1850	1850	1850	1850	MURPHY, MATTHEW
1859	1859	1859	1859	1859	1859	1859	NARDELLA, DANIEL
2020	2020	2020	2020	2020	2020	2020	RODRIGUEZ, TIMOTHY
				2065	2065	2065	SHARPE, DONALD
2092						2092	REID, MATTHEW
2110	2110	2110	2110	2110	2110	2110	SMART, LAWRENCE
2122	2122						CRAWFORD, ANGELA
2147	2147	2147			2147	2147	BUTLER, TOM
2185	2185	2185					THEODORE, ERWIN

L289.DOC

1989

DEC	NOV	OCT	SEP	AUG	JUL	
1083	1083	1083	1083	1083	1083	BENASSI, HOWARD
1169	1169	1169	1169	1169	1169	CAMPBELL, THOMAS
1269	1269	1269	1269	1269	1269	CUTTER, GEORGE
1285	1285	1285	1285	1285	1285	DEAKYNE, CARROL
1289	1289	1289	1289	1289	1289	DE HART, DONALD
1315	1315	1315	1315	1315	1315	DIMILLA, THOMAS
1405	1405	1405	1405	1405	1405	SILVA, JOSEPH
			1422	1422		FRITZLER, FREDERIC
1435	1435	1435	1435	1435	1435	GAMBALE, ALFONSO
1441	1441	1441	1441	1441	1441	GATES, RICHARD
1447	1447	1447	1447	1447	1447	LARSON, JON
1509	1509	1509	1509	1509	1509	HARTNETT, PAUL
1545	1545	1445	1545	1545	1545	HURLEY, PATRICK
1573	1573	1573	1573	1573	1573	JOSEPH, JUNE
1665	1665	1665	1665	1665	1665	LEBLANC, EDGAR
1700	1700	1700	1700	1700	1700	LUND, RAYNOR
1846	1846	1846	1846	1846	1846	MUNDIS, PAUL
			1850	1850	1850	MURPHY, MATTHEW
1859	1859	1859	1859	1859	1859	NARDELLA, DANIEL
2020	2020	2020	2020	2020	2020	RODRIGUEZ, TIMOTHY
2092	2092	2092	2092	2092	2092	REID, MATTHEW
2110	2110		2110	2110	2110	SMART, LAWRENCE
					2185	THEODORE, ERWIN

L190.DOC

1990

JUN	MAY	APR	MAR	FEB	JAN	
1083	1083	1083	1083	1083	1083	BENASSI, HOWARD
1169	1169	1169	1169			CAMPBELL, THOMAS
		1269	1269	1269	1269	CUTTER, GEORGE
1285	1285	1285	1285	1285	1285	DEAKYNE, CARROL
					1289	DE HART, DONALD
		1315	1315	1315	1315	DIMILLA, THOMAS
1405	1405	1405	1405		1405	SILVA, JOSEPH
1435	1435	1435	1435	1435	1435	GAMBALE, ALFONSO
1441	1441	1441	1441	1441	1441	GATES, RICHARD
1447	1447	1447	1447	1447	1447	LARSON, JON
1509	1509	1509	1509		1509	HARTNET, PAUL
1545	1545	1545	1545	1545	1545	HURLEY, PATRICK
1573	1573	1573	1573	1573	1573	JOSEPH, JUNE
1665	1665	1665	1665	1665	1665	LEBLANC, EDGAR
		1700	1700	1700	1700	LUND, RAYNOR
				1846	1846	MUNDIS, PAUL
	1850	1850		1850		MURPHY, MATTHEW
1859	1859	1859	1859		1859	NARDELLA, DANIEL
2110	2110	2110	2110			SMART, LAWRENCE
2147	2147	2147	2147	2147	2147	BUTLER, THOMAS

L290.DOC

1990

DEC	NOV	OCT	SEP	AUG	JUL	
1083	1083	1083	1083	1083	1083	BENASSI, HOWARD
1103	1103	1130	1130	1130		WILLIAMSON, JOHN
		1169		1169	1169	CAMPBELL, THOMAS
1404	1405	1405	1405	1285	1285	DEAKYNE, CARROL
	1422	1422	1422	1405	1405	SILVA, JOSEPH
1435	1435	1435	1435	1422	1422	FRITZLER, FREDERIC
1441	1441	1441	1441	1435	1435	GAMBALE, ALFONSO
1447	1447	1447	1447	1441	1441	GATES, RICHARD
1509	1509	1509	1509	1447	1447	LARSON, JON
		1545	1545	1509	1509	HARTNETT, PAUL
1573	1573	1573	1573	1545	1545	HURLEY, PATRICK
1665	1665	1665	1665	1573	1573	JOSEPH, JUNE
1846	1846	1846	1846	1665	1665	LEBLANC, EDGAR
						MUNDIS, PAUL
1859	1859	1859	1859	1850	1850	MURPHY, MATTHEW
				1859	1859	NARDELLA, DANIEL
				2052	2052	SCHAVRIEN, WILLIAM
				2110	2110	SMART, LAWRENCE
				2185	2185	THEODORE, ERWIN
				2532	2532	GANGON, JEFFREY

L191.DOC

JUN	MAY	APR	MAR	FEB	JAN	
1083	1083	1083	1083	1083	1083	BENASSI, HOWARD
1130	1130	1130	1130	1130	1130	WILLIAMSON, JOHN
			1315	1315	1315	DIMILLA, THOMAS
					1405	SILVA, JOSEPH
1422	1422	1422	1442			FRITZLER, FREDERIC
1435	1435	1435	1435	1435	1435	GAMBALE, ALFONSO
1441	1441	1441	1441	1441	1441	GATES, RICHARD
1447	1447	1447	1447	1447	1447	LARSON, JON
1509	1509	1509	1509	1509	1509	HARTNETT, PAUL
1545	1545	1545	1545	1545	1545	HURLEY, PATRICK
1573	1573	1573	1573	1573	1573	JOSEPH, JUNE
1665	1665	1665	1665	1665	1665	LEBLANC, EDGAR
1846	1846	1846	1846	1846	1846	NARDELLA, PAUL
1850						MURPHY, MATTHEW
1859	1859	1859	1859		1859	NARDELLA, DANIEL
2110	2110	2110	2110			SMART, LAWRENCE
3337						LABELLE, PAIGE
						GIDEON, SAUL
	3062					

L291.DOC

1991

JAN-92	DEC	NOV	OCT	SEP	AUG	JUL	
1083	1083	1083	1083	1083	1083	1083	BENASSI, HOWARD
1130	1130	1130	1130	1130	1130	1130	WILLIAMSON, JOJN
						1315	DIMILLA, THOMAS
						1422	FRITZLER, FREDERIC
1435	1435	1435	1435	1435	1435	1435	GAMBALE, ALFONSO
1441	1441	1441	1441	1441	1441		GATES, RICHARD
1447	1447	1447	1447	1447	1447	1447	LARSON, JON
1509	1509	1509	1509	1509	1509	1509	HARTNETT, PAUL
	1545	1545		1545	1545	1545	HURLEY, PATRICK
1573	1573	1573	1573	1573	1573	1573	JOSEPH, JUNE
1665	1665	1665	1665	1665	1665	1665	LEBLANC, EDGAR
1846	1846	1846	1846	1846	1846	1846	MUNDIS, PAUL
			1859	1859	1859	1859	NARDELLA, DANIEL
			2095	2095			NEWELL, SHAWN
					2110	2110	SMART, LAWRENCE
					3337	3337	LABELLE, PAIGE

L:192.DOC

1992

JUN	MAY	APR	MAR	FEB	
		1130	1083	1083	BENASSI, HOWARD
	1130	1130	1130	1130	WILLIAMSON, JOHN
			1435	1435	GAMBALE, ALFONSO
	1441	1441	1441	1441	GATES, RICHARD
		1447	1447	1447	LARSON, JON
			1509	1509	HARTNETT, PAUL
				1545	HURLEY, PATRICK
				1573	JOSEPH, JUNE
	1665	1665	1665	1665	LEBLANC, EDGAR
1846	1846	1846	1846	1846	MUNDIS, PAUL
			1859	1859	NARDELLA, DANIEL
		2095			NEWELL, SHAWN
			2110		SMART, LAWRENCE